Intuitive and coherent intraretinal cystoid map representation in Optical Coherence Tomography Images

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Abstract. In this work, we present a robust and fully automatic methodology for the identification and analysis of intraretinal cystoid fluid regions in Optical Coherence Tomography images (OCT). This methodology is focused on offering coherent representations of the intraretinal fluid regions by means of an intensive sampling of the OCT image followed by an intuitive colored representation. These representations can help in the early detection, diagnosis and prognosis of pathologies like the Age-Related Macular Degeneration (AMD) and the Diabetic Macular Edema (DME).

Keywords: Optical Coherence Tomography, intraretinal cystoid fluid regions, Computer-aided diagnosis, pathology map generation

1 Introduction

Optical Coherence Tomography (OCT) has become one of the leading medical imaging techniques for the diagnosis of eye related pathologies like Age-Related Macular Degeneration (AMD) and Diabetic Retinopathy (DR). These diseases present, as common symptom, fluid accumulations between the retinal layers. Being both amongst the principal causes of blindness in developed countries and also critically dependent on an early diagnosis, the detection of these cystoid fluid structures became a significant matter in the ophthalmological field.

The current tendency in the cystoid fluid detection issue is focused on obtaining a precise segmentation. However, this segmentation may not always be possible. Cystoid bodies may present a diffuse contour, fused with the retinal tissues. Consequently, the development of a complementary technique that works independently of the cystoid fluid structure conditions can represent a sensible improvement, aiding clinicians to better assess the impact and development of these pathologies.

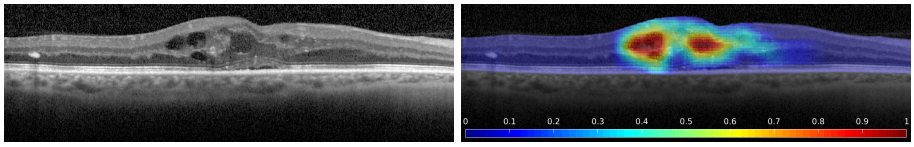
2 Methodology

The entire system is divided into 3 stages [1]. First of all, the region of interest (ROI) in the OCT image is extracted by segmenting the outermost and innermost retinal layers. Afterwards, the system extracts square windows from the OCT

image to determine the fluid presence. To maintain the robustness of the system near the limiting membranes of the retina, an specific algorithm was designed to extract the biggest ROI squared subsample from each sample. This way, we avoid to include the presence of the vitreous humour that could be confused with the intraretinal fluid, as well as preserving the spatial information that is useful in the analysis. Finally, intensive and organized overlapping samples are identified and classified using a previously trained model [2] into the two considered classes and used to generate the intuitive colored fluid region maps. This intensive analysis permits the system to create coherent and resilient maps even in the problematic areas, using information from the neighborhood to evaluate each region.

3 Results and Conclusions

The system was able to correctly identify the cystoid fluid regions consistently along the tested images. The biggest ROI extraction phase for each sample offers a robust performance in the retinal limits, avoiding the complications of the vitreous humour. Additionally, the intensive and organized sampling produces a robust regional identification and representation, suitable for a coherent analysis, as seen in Figure 1.



(a) (b)

Fig. 1. Original OCT image with multiple pathological structures (a) and resulting color fluid presence map (b).

Acknowledgments

This work is supported by the Instituto de Salud Carlos III, Government of Spain and FEDER funds of the European Union through the DTS15/00153 research projects and by the Ministerio de Economía y Competitividad, Government of Spain through the DPI2015-69948-R research project. Also, this work has received financial support from the European Union (European Regional Development Fund - ERDF) and the Xunta de Galicia, Centro singular de investigación de Galicia accreditation 2016-2019, Ref. ED431G/01; and Grupos de Referencia Competitiva, Ref. ED431C 2016-047.

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